US005936586A

United States Patent [19]

Maloney

[11] Patent Number: 5,936,586
[45] Date of Patent: Aug. 10, 1999

[54] **VHF-UHF WAVEGUIDE NON-METAL AND METAL DETECTOR**

[76] Inventor: **Daniel P. Maloney**, Rt. 1, Box 313G, 1163 120 St., Roberts, Wis. 54023

[21] Appl. No.: **08/841,206**

[22] Filed: **Apr. 29, 1997**

[51] **Int. Cl.**[6] **H01Q 1/16**

[52] **U.S. Cl.** **343/742**; 343/741; 343/744; 343/890

[58] **Field of Search** 343/741, 742, 343/743, 744, 879, 890, 891, 748, 895, 896; H01Q 1/16

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,550,137	12/1970	Kuecken	343/744
5,138,262	8/1992	Podhrasky	324/327
5,621,418	4/1997	Maloney	343/742
5,696,490	12/1997	Maloney	340/555

Primary Examiner—Robert H. Kim
Assistant Examiner—Layla Lauchman

[57] **ABSTRACT**

A VHF-UHF waveguide non-metal and metal detector is disclosed having a waveguide antenna system of aluminum tubing with 4 aperture/slits at critical angles including dielectric centers in conjunction with a waveguide collector system of 2 sets of conical collectors mounted on a main unit containing a waveguide diaphragm and waveguide receiver case including receiver antenna wires with no metal contact.

1 Claim, 5 Drawing Sheets

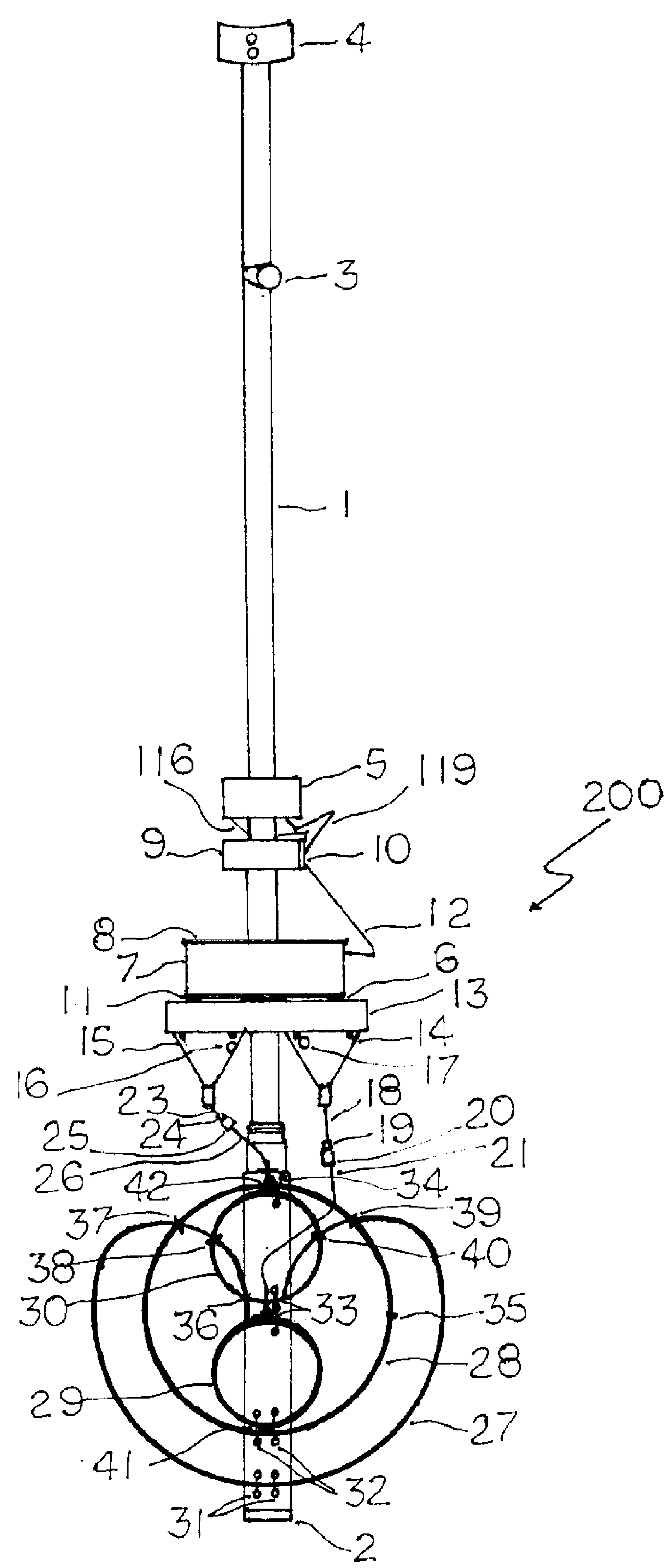
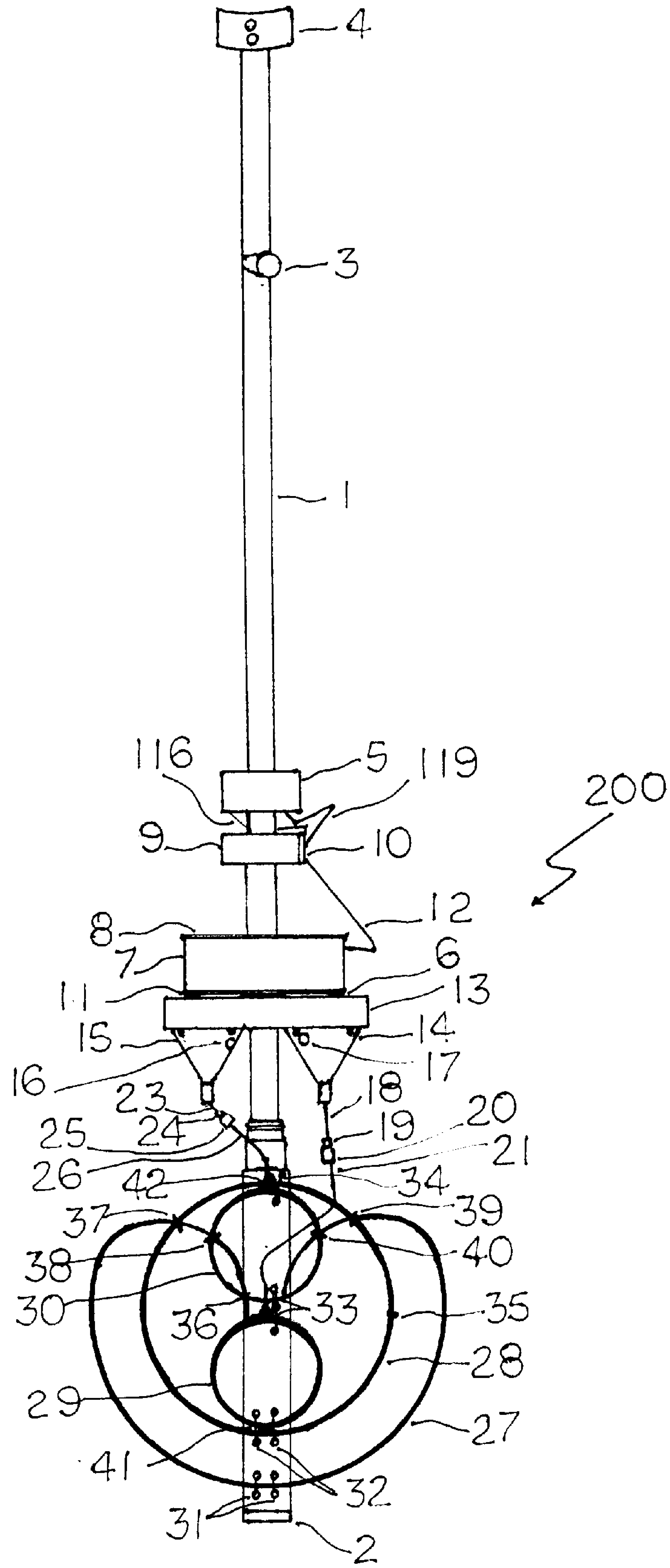


FIG. 1


4
3
1
116
5
119
200
9
10
12
8
7
6
11
13
15
14
16
17
23
18
25
24
19
20
21
26
42
34
37
39
38
40
30
36
33
35
28
29
27
41
32
31
2

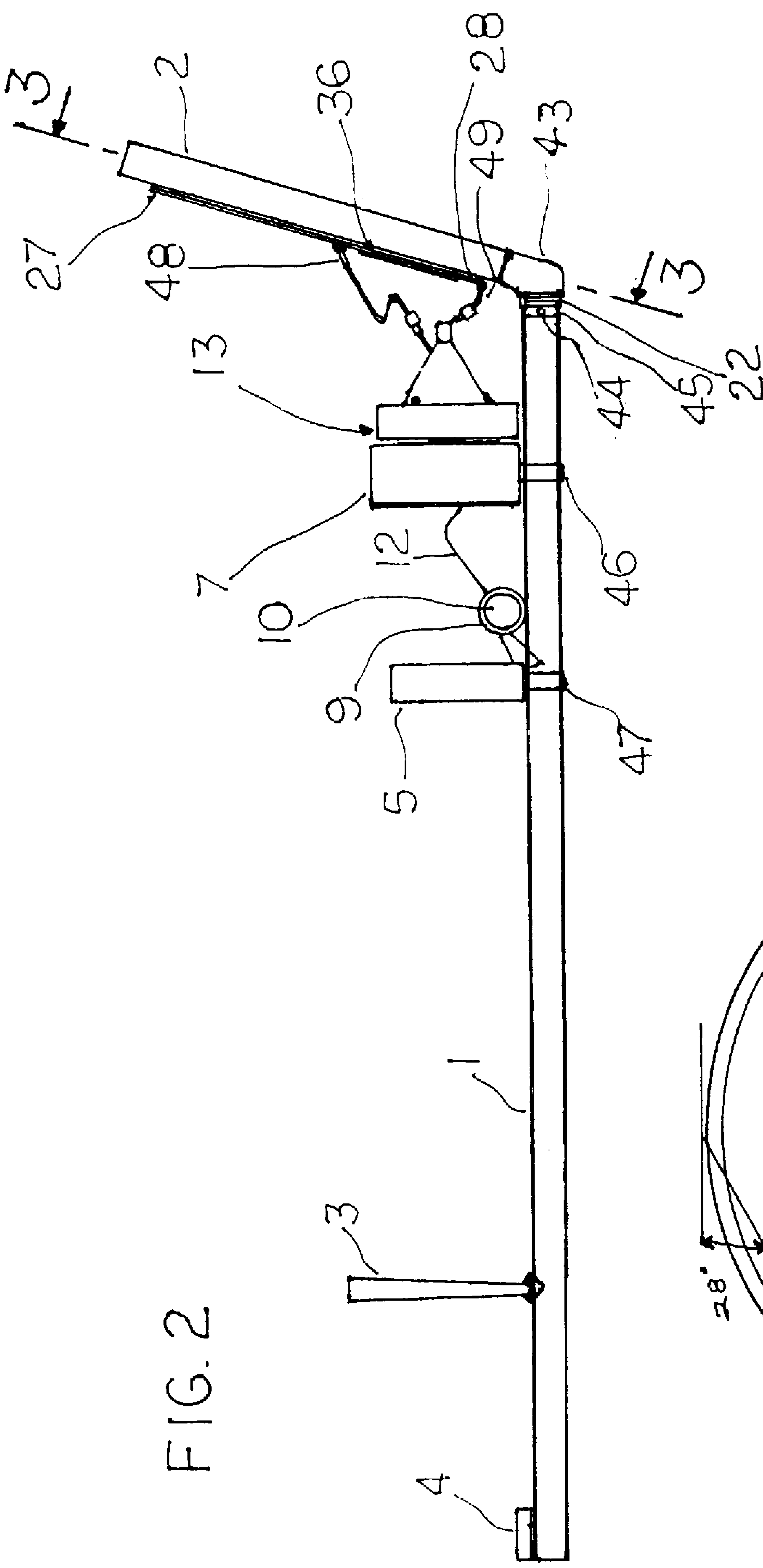
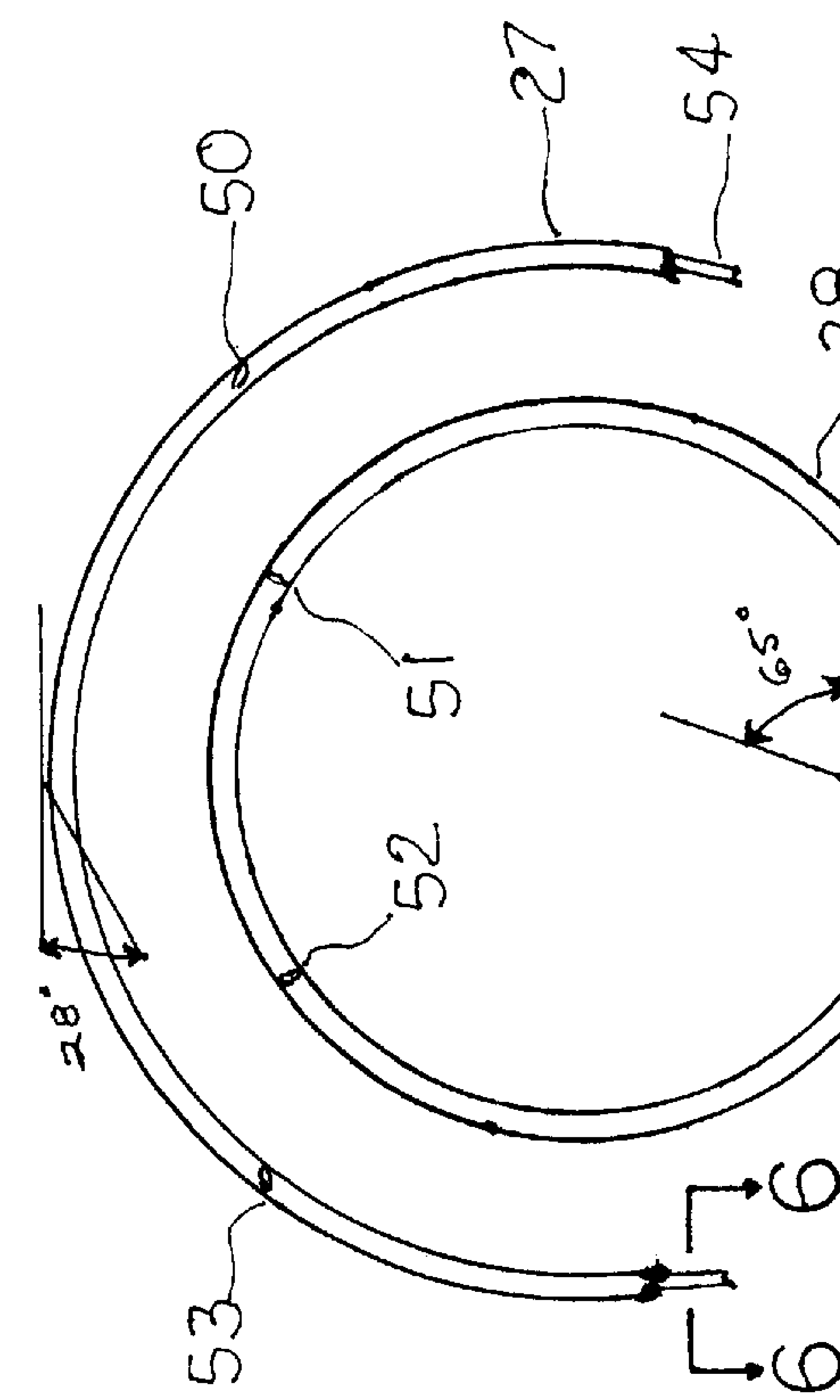

3
2
36
28
49
43
27
48
3
13
22
44
45
7
12
46
10
9
47
5
1
3
4

FIG. 2

FIG. 3


27
54
50
28
69
51
65°
52
28°
53
6
6

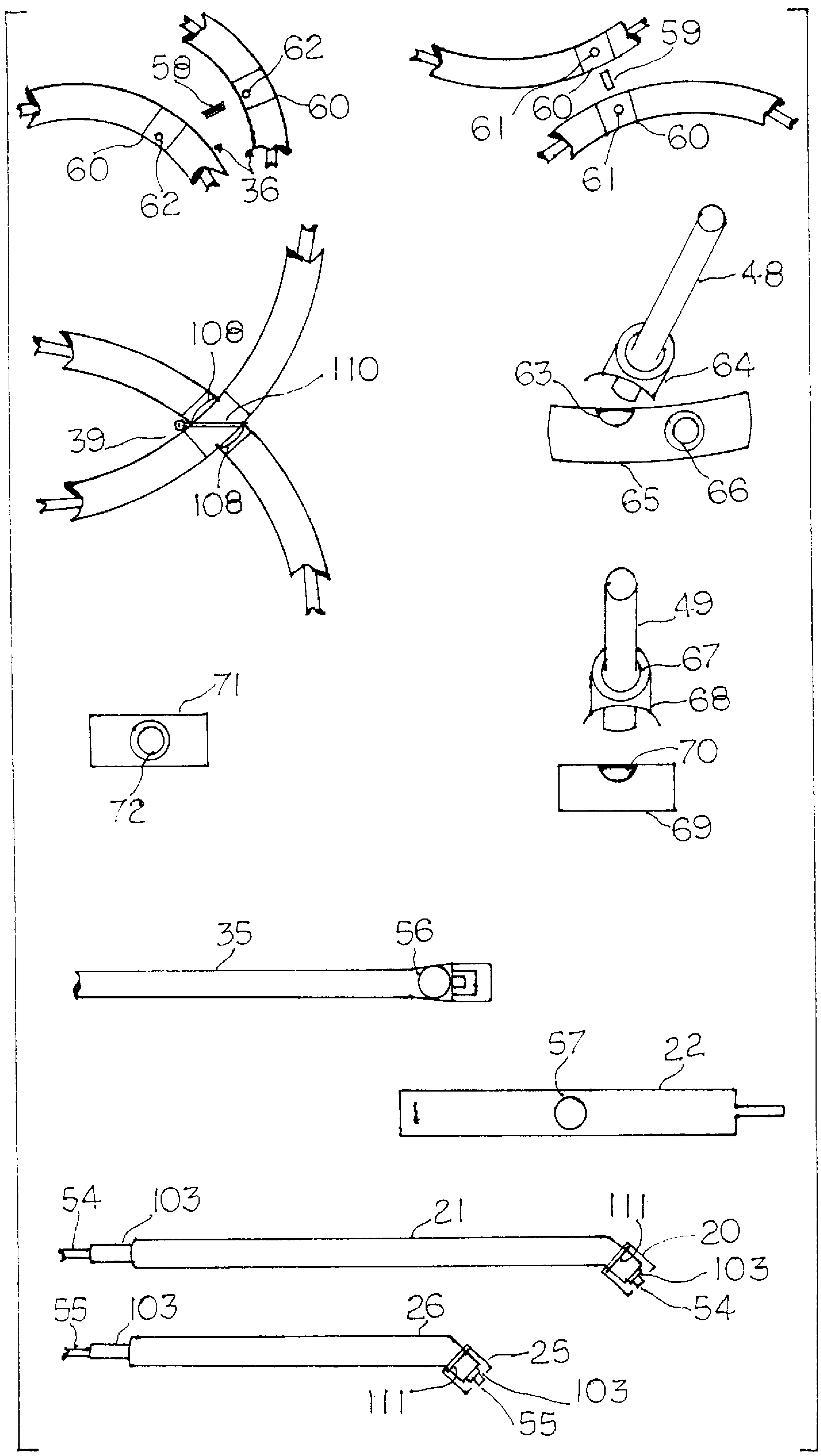
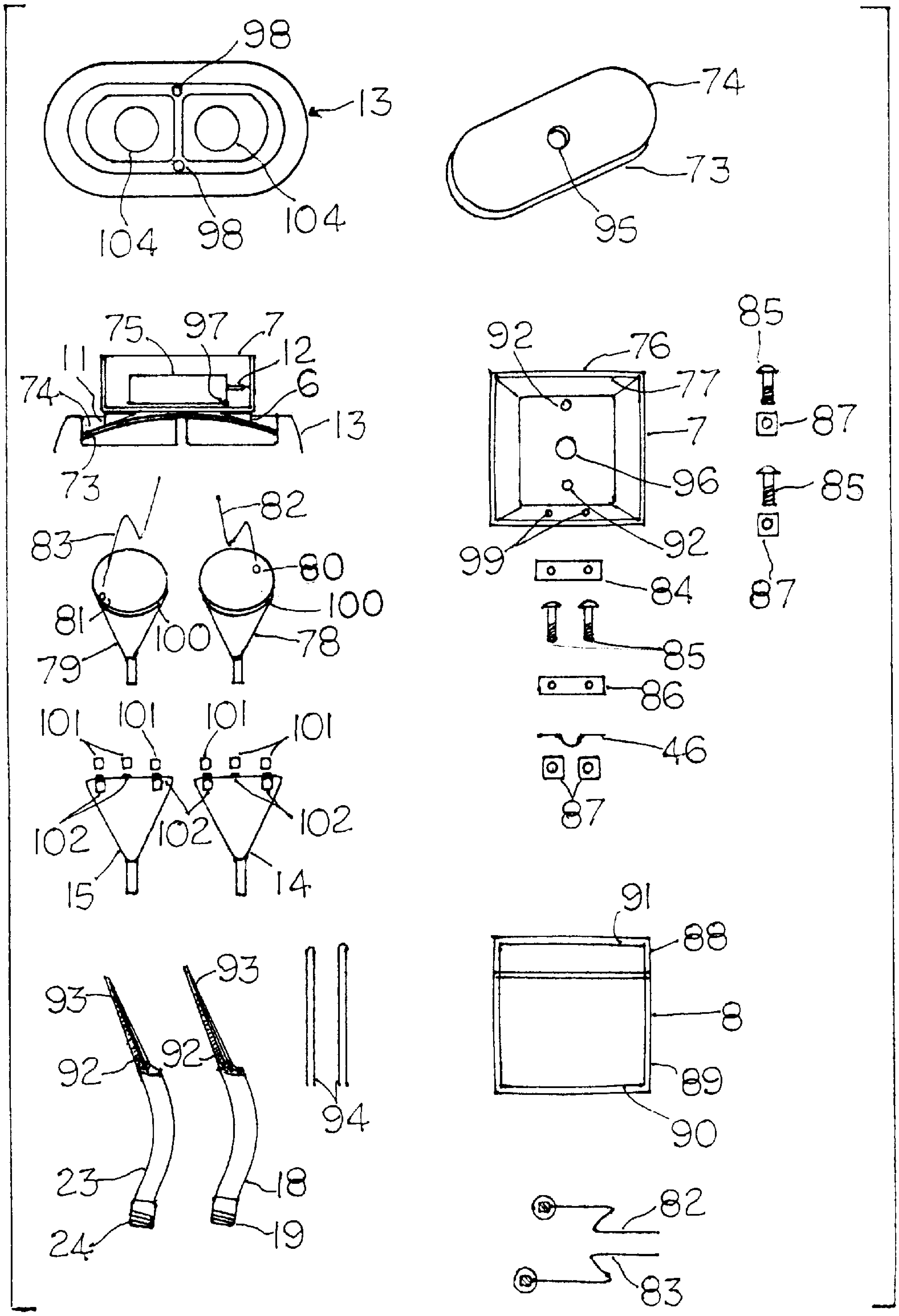

58
62
60
60
62
36
59
61
60
60
61
108
110
39
108
48
63
64
65
66
49
67
68
71
72
70
69
35
56
57
22
54
103
21
111
20
103
54
55
103
26
25
111
103
55

FIG. 4

FIG. 5


98
13
104
98
104
74
73
95
75
97
7
12
11
6
74
13
73
92
76
77
7
96
92
99
85
87
85
87
83
82
80
81
100
100
79
78
84
85
86
46
87
101
101
101
101
102
102
102
15
14
91
88
8
89
90
93
93
92
92
94
23
18
24
19
82
83

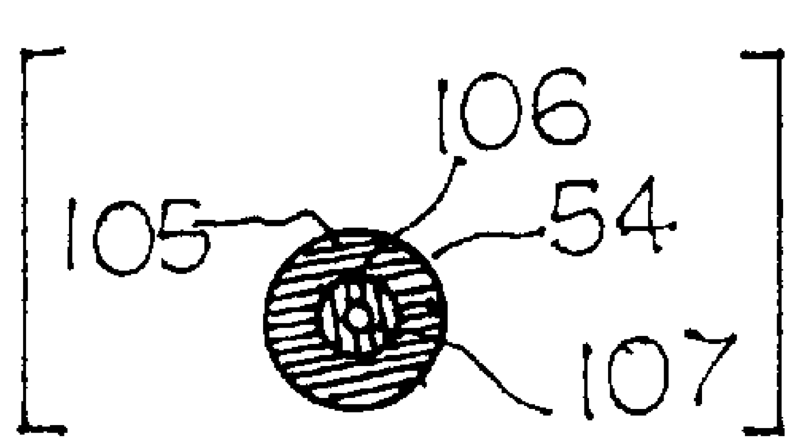
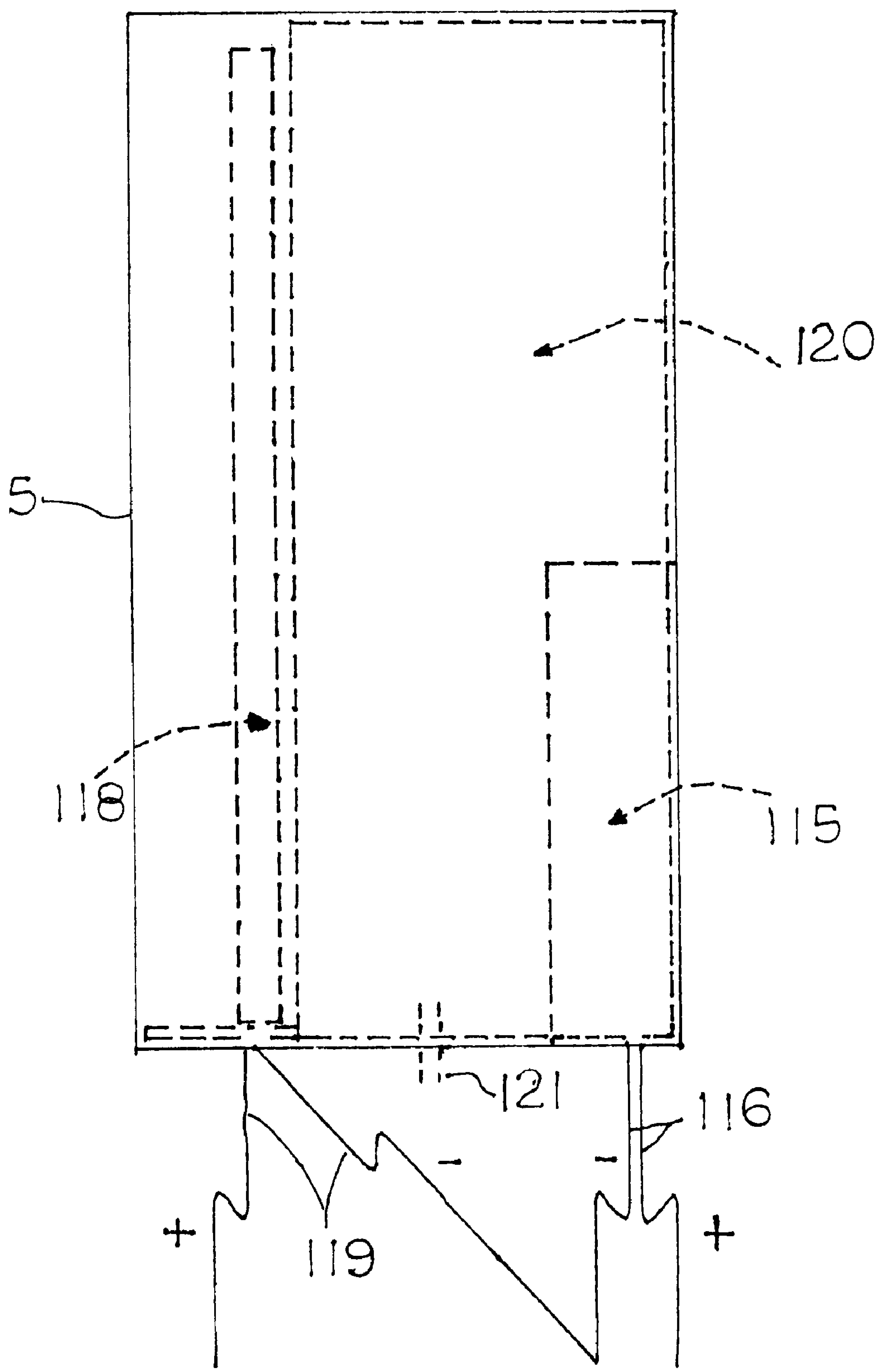

106
105
54
107

FIG. 6

FIG. 7



VHF-UHF WAVEGUIDE NON-METAL AND METAL DETECTOR

BACKGROUND OF THE INVENTION

The field of this invention relates generally to non-metal detectors and metal detectors using UHF (ultra high frequency) and VHF (very high frequency) and VHF-FM propagated radio and television waves several hundred feet deep in the ground (or other conductive environment) or less and responsive to detection of non-metal and metal objects in any environment which allows detection.

In regards to the background of the invention the prior art in most cases uses long cables to attach search instruments to detector, tuning is hard to do and some use very long lengths of electrical cable stretched out across the surface of the ground to transmit and detect objects. Most all of the prior art detectors will not detect plactic, glass, or similar types of objects, but instead are metal detectors.

SUMMARY OF THE INVENTION

Accordingly, an important object of the present invention is to provide an efficient, uncomplicated, lightweight, UHF-VHF, VHF-FM non metal and metal detector with extreme sensitivity to propagated radio/television waves several hundred feet deep in the ground (or other conductive environment) or less and any environment which allows detection.

Another object of the invention is to provide a rigid antenna for a more rugged environment.

Another object of the invention is to provide easier tuning and selection for search pass of the detection system.

In accordance with one aspect of the present invention, it is provided with a waveguide antenna system with 4 aperture/slits at critical angles and a waveguide collector system which also acts as two more detectors.

In accordance with another aspect of the present invention further objects as mentioned above are accomplished by an aluminum tube waveguide antenna with a dielectric center and with aluminum and plastic waveguide collector detectors allowing a larger range and easier selection of tuning.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view showing essential features of my invention.

FIG. **2** is a right elevational view showing waveguide system.

FIG. **3** is a sectional view along line **3**—**3** of FIG. **2**.

FIG. **4** is an enlarged view illustrating the individual connections which comprise the waveguide antenna system according to the invention.

FIG. **5** is an enlarged view illustrating the individual components/sections which comprise the waveguide collector system according to the invention.

FIG. **6** is a sectional view taken along line **6**—**6** of FIG. **3**.

FIG. **7** is an illustration of the case **5** which includes a battery package and digital meter.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, there is shown from the drawing a VHF-UHF Waveguide Non-Metal/Metal Detector, System **200**, which comprises an ¼ inch aluminum tube waveguide antenna FIG. **1** and a **3** layer FIG. **6**, vinyl **105**, polypropylene **106**, and nylon **107**, dielectric in two full lengths inside the tube system FIG. **3**, FIG. **4**, **54** & **55** and FIG. **6** and consisting of modified loops **29** and **30** FIG. **1**, a full curve antenna **27** FIG. **1** connected to each loop **29** and **30**, a full circle non-directional antenna **28** FIG. **1** with full curve antenna **27** on top of full circle antenna **28** and loop **30** at crossover points, 14½ in. W×13½ in. L.

The full circle antenna **28** has aperture/slits **51** & **52** FIG. **3** and **51** & **52** are placed at an angle of 65° FIG. **3** from a line two inches, FIG. **3** above the inside of the bottom of the full circle antenna **28**. The full curve antenna **27** FIG. **3** also has aperture/slits **50** & **53** FIG. **3**. The aperture/slits **50** & **53** are placed at a 28° angle FIG. **3** from a line across the outside of the full curve loop FIG. **3**. The aperture/slits are ⅛ inch long by 3/64 inch wide and made with a flat file until a needle point can be pushed through the middle first then carefully push needle through ends until an eye type aperture is made.

The full circle antenna **28** FIG. **1** has a 3 layered dielectric **55** FIG. **4** and FIG. **6**, running all the way through in one piece and out the aluminum connecting tube **49** FIGS. **2** & **4**. The inside of rubber tube **26** FIG. **4**, which is the outside of a coax antenna has a rolled up aluminum foil **103** FIG. **4** to shield the dielectric and act as a guide.

The full curve antenna **27** FIG. **1** has a 3 layered dielectric **54** FIG. **4** and FIG. **6** running all the way through the loops **29** and **30** and out aluminum connecting tube **48** FIG. **2** and FIG. **4** and also up through connecting tube **21** FIG. **1** and FIG. **4**. The inside of rubber tube **21** FIG. **4** which is also the outside of a coax antenna, has a rolled up aluminum foil **103** FIG. **4** to shield the dielectric and act as a guide. The dielectric used in this invention in **54** and **55** FIG. **4** is clothesline.

The waveguide antenna system has interaction connections at points **39**, **40**, **41**, **37**, **38** and **42** FIG. **1**. These have 3/32 of an inch hole **60** FIG. **4** and a ⅛ inch long hollow plastic tube **59** FIG. **4** is inserted through electrical tape **60** and hole **61**. The joint such as **39** FIG. **1** and FIG. **4** has a narrow aluminum foil strip **108** FIG. **4** wrapped tight and not touching the ¼ inch aluminum tube and has adhesive applied to keep it tight. An 8 inch long by 3/16 inch electrical nylon tie **110** is pulled tight and locked to secure the joints FIG. **4**. The joints at **41** and **42** FIG. **1** do not have the nylon tie **110** FIG. **4** directly on them. At **41** and **42** FIG. **1** the nylon ties **32** and **34** FIG. **1** secure the aluminum tubes together as well as to wood frame **2** FIG. **1**. At point **36** FIG. **1** a 1/16 of an inch hole is used because of the interaction point. In FIG. **4** a 1/16 of an inch hole **62** is drilled into the two tubes on the outside bottom. A group of 5 polypropylene fibers **58** FIG. **4** is inserted into the 1/16 inch holes **62** and also through the holes in the electrical tape **60**. There is aluminum foil wrapped around the joint and adhesive applied to keep it tight and a nylon tie is not used.

The ¼ inch aluminum full circle antenna **28** FIG. **1** has a sleeve **69** FIG. **4** and is inserted into the ends. The sleeve **69** also has a hole **70** FIG. **4** for the ¼ inch aluminum tube **49** to fit into. The tube **49** has a reinforcer sleeve **68** and fixed inside sleeve **67** as well as all the sleeves **69**, **65** and **71** FIG. **4** do. The tube and assembly are secured with a semiconductor muffler repair cement made by Locite. The full curve antenna **27** is inserted into sleeve **65** FIG. **4** hole **66** and the ¼ inch aluminum tube **48** is down through the reinforcer sleeve **64** and inserted through hole **63** FIG. **4**. The loop **29** is inserted into the ends of sleeve **65** FIG. **4**. All of these tubes and sleeves are machine fit and again Locite semiconductor muffler repair cement is used to secure the joints. The other end of the full curve antenna **27** is inserted into sleeve **71** FIG. **4** by sleeve hole **72**. The lower loop **30** FIG. **1** is inserted into the ends of sleeve **71**. All the tubes and sleeves here are also machine fit and Locite cement is used.

The rubber connecter tubes **21** and **26** FIG. **1** and FIG. **4** has the dielectric **54** and **55** long enough from the tubes **48** and **49** FIG. **2** and FIG. **4** to insert and come all the way up through connecting tubes **21** and **26** FIG. **4**. The rubber connecting tubes **21** and **26** have aluminum foil liners **103** FIG. **4** and are slipped over the connecting tubes **48** and **49** about ⅜ of an inch and secured with silicon adhesive.

The aluminum tube waveguide system is secured to wood frame **2** FIG. **1** with the 8 inch by $3/16$ inch electrical nylon ties at **31, 32, 33** and **34** FIG. **1**.

A torque dipole unit **35** FIG. **1** and FIG. **4** is a 1.4 volt hearing aid battery **56** FIG. **4** bonded to the 8 inch by $3/16$ inch nylon electrical tie so the tie may be pulled tight on to the outside of aluminum tube with negative battery side on aluminum tube of the full circle antenna **28** FIG. **4**. The dipole applies a torque to the outside of the tube antenna and allows the aperture/slits **50, 51, 52** and **53** FIG. **3** to work smooth and efficient. This point at **35** FIG. **1** was determined from performance and electrical potential at **35** FIG. **1**, which is across from the lower loop sleeve **72** FIG. **1**.

The waveguide collector system utilizes the dielectric as a conductor and the metal as a guide. The main mounting unit **13** FIG. **1** and FIG. **5** is a moulded unit with two bowl like sides. The receiver case **7** FIG. **1** and FIG. **5** has a plastic shell **77** and a aluminum shell **76** FIG. **5** on the outside. It is provided with mounting holes **92** FIG. **5** to mount to main unit **13** in holes **98** FIG. **5** and bolts and nuts **85** and **87** are used to secure it.

A waveguide diaphragm **73** FIG. **5** which is plastic and waveguide diaphragm **74** which is aluminum, both are glued together by silicon, are 8¼ inches long by 3¾ inches wide. The waveguide diaphragms **73** and **74** are placed between main unit **13** and receiver case **7** FIG. **5**. The case **7** has a hole **96** which is ⅞ of an inch wide, and the waveguide diaphragms **73** and **74** FIG. **5** also have a hole **95** which is ⅞ of an inch wide. The holes fit over the midsection of main unit **13** FIG. **5**. The waveguide diaphragms **73** and **74** are pushed down on the ends into the main unit **13** by styrofoam wedges **6** and **11** FIG. **1** and FIG. **5**.

The main mounting unit has 2 large holes **104** FIG. **5**. The plastic funnels **78** and **79** FIG. **5** are 3⅜ of an inch across and each have a hole **80** and **81** FIG. **5**. The plastic funnels **78** and **79** with the holes **80** and **81** FIG. **5** would be mounted on main unit **13** in exactly this position, that is right where they are located in the drawing FIG. **5, 78** and **79**. The antenna receiver wires have pads of braided copper wire soldered on the end of wires **82** and **83** FIG. **5**. These are taped over the holes **80** and **81** FIG. **5** with duct tape **82** and **83** FIG. **5**.

The coax antenna cables **23** and **18** FIG. **1** and FIG. **5** with center wire pulled out are sliced to leave an angle and plastic **93** and copper braiding 95% shield **92** FIG. **5**, have electrical tape **94** FIG. **5** applied tight over **92** and **93** FIG. **5**. These are inserted up into aluminum funnels **14** and **15** FIG. **1** and FIG. **5** and plastic funnels **78** and **79** FIG. **5** are inserted in aluminum funnels **14** and **15** so that ¾ of an inch of the sliced and taped coax cables **23** and **18** FIG. **5** are up and in between the ends of plastic funnels **78** and **79** and the aluminum funnels **14** and **15** FIG. **5**. The coax cable **18** and **23** FIG. **5** should be secured with a strong adhesive like goop to both plastic funnels **78** and **79** and aluminum funnels **14** and **15** which will prevent them from pulling out. The waveguide connections must be so that no wires are touching the aluminum collector funnels. The plastic collector funnel must have an aluminum foil **100** FIG. **5** wrapped tightly around the top so it will seal the aluminum collector funnels **14** and **15** FIG. **5** and an adhesive applied to keep it tight.

The conical funnel collectors **14** and **15** are mounted on the main unit **13** over the large holes **104** FIG. **5** and secured with velcro **101** and **102** FIG. **5**. The velcro **101** and **102** are secured with a strong adhesive like auto goop, on main unit **13** and aluminum collector funnels **14** and **15** FIG. **5**.

The aluminum conical funnels **14** and **15** FIG. **1** and FIG. **5** have torque dipoles taped by a patch of duct tape **16** and **17** FIG. **1**, with the negative side of the 1.4 volt hearing aid battery on the aluminum metal.

The receiver wires **82** and **83** FIG. **5** enter the case **7** through main unit **13** at holes **104** and diaphragms **73** and **74** holes **95** and receiver case hole **96** FIG. **5**. Wire **82** is inserted and wrapped at first end of receiver antenna **97** FIG. **5** and receiver wire **83** is inserted and wrapped at second end of receiver antenna **97** FIG. **5**. Headphone speaker wire **12** FIG. **1** and FIG. **5** are shown in the case FIG. **5** and outside on FIG. **1**.

The receiver case **7** FIG. **5** supports the waveguide collector units with bracket **46** FIG. **2** and FIG. **5** around main wood frame **1** FIG. **2**. A ⅛ inch leather strap **84** FIG. **5** is placed inside receiver case **7** over holes **99**, two bolts **85** FIG. **5** are inserted through **84** and **99** FIG. **5** and a ⅛ inch thich leather strap **86** is put on bolts **85** outside case **7** and mounted on main wood member **1** FIG. **2**. The nuts **87** FIG. **5** are turned tight against metal strap **46** FIG. **2** and FIG. **5**.

When the waveguide antenna system is connected to the waveguide collector system, connecters **19** and **20** FIG. **4** and FIG. **5** are used. The plastic connecters **19** and **20** are waterproof type used on submersible well pumps. The coax antenna **18** FIG. **5** with braided copper wire and plastic inside are inserted and glued to **19**, ½ way back up threads. The female plastic coupler **20** FIG. **4** has the rubber coax, incased aluminum foil **103** and the dielectric **54** FIG. **4** all the way through. The foil **103** is over the top and pushed down to fit against the copper braid of **18** FIG. **5** when turned together. There is a rubber ring **111** FIG. **4** which is put on the coax rubber and glued to keep coupler **20** FIG. **4** from pulling off. The plastic connecters **24** and **25** FIG. **1**, FIG. **4** and FIG. **5** are the same type. The coax antenna **23** FIG. **5** with braided copper wire and plastic inside are inserted and glued to **24**, ½ way back up threads. The female plastic coupler **25** FIG. **4** has the rubber coax, incased aluminum foil **103** and the dielectric **55** FIG. **4** all the way through. The foil **103** is over the top and pushed down to fit against the copper braid of **23** FIG. **5** when turned together. There is a rubber ring **111** FIG. **4** which is put on the coax rubber and glued to keep coupler **25** FIG. **4** from pulling off.

It is important to note here that both sets of waveguide collectors **14** and **15** FIG. **1** and main unit **13** FIG. **1** along with the diaphragms **73** an **74** FIG. **5** and waveguide receiver case **7** FIG. **1** and FIG. **5** act as detectors for both non-metal and metal. The total waveguide system has the four aperture/slits **50, 51, 52** and **53** FIG. **3** and the 2 collector systems **14** and **15** FIG. **1** working in harmony as detectors, thereby increasing the sensitivity and with better coverage for both non-metal and metal.

The main wood frames **1** and **2** FIG. **1** and FIG. **2** have a ¾ inch 45° elbow **43** FIG. **2** and a 2 inch long ¾ inch connecter **45** FIG. **2** where handle wood frame **1** goes into and a pin **44** FIG. **2** which secures it. A torque dipole **57** attached to aluminum strap **22** FIG. **2** and FIG. **4**, with the dipole being a 1.4 volt hearing aid battery with the negative side on the aluminum strap **22** FIG. **4**.

Receiver case **7** FIG. **1** and FIG. **5** has a waveguide cover **8** FIG. **1** which is in two pieces, and plastic inside and aluminum outside. The top **91** plastic **88** aluminum FIG. **5**. The lower part plastic **90** and aluminum **89** FIG. **5**. They are both put together by silicon adhesive between the plastic and aluminum. The bottom **89** and **90** FIG. **5** of cover **8** FIG. **1** and FIG. **5** removes and slides in or out.

Referring now to FIG. **7** there are shown additional details of the meter case **5**. Included within the case is a 1½ volt AA battery retainer **115** FIG. **7** with + and − wires **116** out the bottom. Styrofoam **120** FIG. **7** restrains the battery retainer **115** and supports the digital meter **118** which has + and − wires **119** out the bottom. The + battery wire **116** goes to the infrared phototransistor detector in tube **10** FIG. **1**. Aluminum tube **10** FIG. **1** is secured by plastic sleeve **9** FIG. **1**. The + meter wire **119** also goes to the other connection on the infrared phototransistor detector in tube **10** FIG. **1**.

The headphone speaker plug-in wires **12** FIG. **1** from receivers from receivers VHF-UHF goes to the krypton bulb in aluminum case **10** FIG. **1** which transmits data to infrared phototransistor detector. Meter case **5** is mounted on strap **47** FIG. **2** with bolts at **121** FIG. **7**. Armrest **4** FIG. **1** and FIG. **2** is used to support the instrument and handgrip **3** FIG. **1** and FIG. **2** is used to lift and guide the instrument.

The receiver wires **82** and **83** FIG. **5** were connected up to an extended double wire antenna to the UHF-VHF on a portable television and the instrument worked very well directly on several channels without any further tuning at all. The detector detected plastic, glass and metal which I buried about 8 inches deep with a meter reading of 1450 to 1500 millivolts. The plastic was from 2 to 4 inches across. The glass was about 1½ inches across. The FM receiver was set at about 0–30 millivolts DC with the tuner and the VHF-FM responded extremely well to the plastic, glass and metal upon detecting and with a digital meter reading of 1450 to 1500 millivolts DC as well. The VHF-FM also responded well upon detection of plastic and copper wire telephone wires buried about 3 feet under the ground and with about the same reading.

The above described preferred embodiment provides a highly efficient detection instrument for non-metal and metal and has 4 aperture/slits and 2 conical collectors all using a waveguide technique with torque dipoles for a smooth efficient detection instrument.

What is claimed is:

1. A VHF-UHF waveguide non-metal and metal detector comprising:

a waveguide antenna system of aluminum tubing and dielectric center with 4 aperture/slits at critical angles, 2 on a full circle section and 2 on the full curve section;

a torque dipole on full circle aluminum tube antenna at critical point across from top of lower loop and sleeve assembly with dipole being a 1.4 volt battery mounted on nylon electrical tie and locked on the outside of full circle antenna with negative side of battery on aluminum tube;

a second dipole taped and sealed with silicon mounted on an aluminum strap with negative of 1.4 volt battery on aluminum strap and strap secured around main frame connecter;

a waveguide collector system of 2 sets of plastic and aluminum conical funnels inserted into each other with each set the plastic inserted into the aluminum conical funnel and the 2 sets of conical funnels acting as and doing detection of non-metals and metal when mounted on main waveguide unit;

said main waveguide collector unit having a flexable diaphragm of plastic inside and aluminum outside bonded together and held down at outer edges into main unit by 2 styrofoam wedges below waveguide receiver case of plastic inside and aluminum outside and having the 2 sets of conical funnels attached to bottom outside of main unit over 2 holes being ½ inch smaller then each inside of the 2 plastic conical funnels;

a waveguide connection system into the 2 sets of conical collector funnels and between small ends of plastic and aluminum conical collector funnels with no metal contact;

a set of receiver antenna wires with braided copper end pads taped over ⅛ inch holes in plastic conical funnels being ¾ of an inch down from the top and at the 8 o'clock and the 2 o'clock positions within plastic conical funnels with no metal contact and wires through larger mounting holes and diaphragm and receiver holes in center of units to be secured to VHF and UHF receiver units as needed;

a set of torque dipoles on the outside of aluminum conical funnels at inside upper positions and being 1.4 volt batteries taped on with negative side of battery on aluminum.

* * * * *